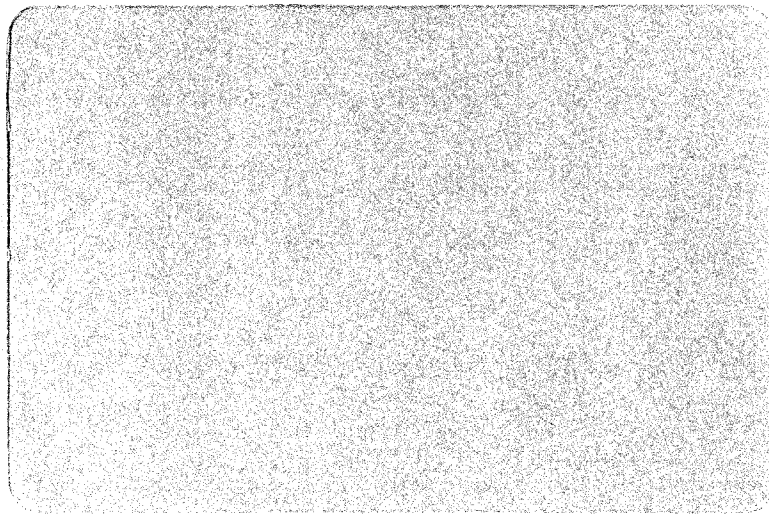




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**GEOPROBE INVESTIGATION  
SUMMARY REPORT**

**AT THE**

**BRINKERHOFF ROAD FACILITY  
KANSAS CITY, KANSAS**

**PREPARED FOR:**

**UNION CARBIDE CORPORATION  
3200 KANAWHA TURNPIKE  
SOUTH CHARLESTON, WEST VIRGINIA**

**PREPARED BY:**

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ENVIROGEN PROJECT NO. 57122**

**October 16, 1995**

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## 1.0 INTRODUCTION

The following report summarizes ENVIROGEN Inc's Geoprobe investigation, point permeability testing and brief in-situ air sparging (IAS) feasibility testing at the Brinkerhoff Road facility in Kansas City, Kansas (Site). The work was conducted during the week of August 28, 1995 in accordance with ENVIROGEN's work plan provided to Union Carbide Corporation (UCC) dated July 31, 1995.

The Site was operated as a transformer decontamination and reclamation facility from 1988 to 1991 and is located in the Fairfax Industrial District of Kansas City, Kansas. Trichloroethylene (TCE) and Polychlorinated Biphenol (PCB) contamination at the Site however, was believed to have occurred during earlier operations from the period 1983 to 1986.

The current conceptual model of Site hydrogeology and subsurface contaminant distribution was developed by UCC and is summarized in the Baseline Risk Assessment and Groundwater Quality Report for the Site dated September, 1994 (Risk Assessment). The major assumptions of the current conceptual model are as follows:

- \* No deep pool of dense non-aqueous phase liquids (DNAPLs) exists.
- \* Dissolved TCE concentrations in groundwater decrease with depth.
- \* A small area of vadose and saturated zone soils in the vicinity of the northwest corner of the building may be acting as the source of dissolved TCE contamination in groundwater.
- \* Elevated concentrations of dissolved TCE in groundwater are found in the near-source area and are mostly restricted to on-site locations.

Additional Site data available from the Risk Assessment report indicates that Site soils are comprised of alluvial flood plain deposits consisting of cohesive and fine grained granular soils with a general increase in grain size with depth. Soil borings advanced in the TCE source area demonstrate that the soils from grade to the groundwater table (ranging from 18 - 22 feet below grade) range from clayey silts to silty fine sands. Soils below the groundwater table grade from very fine sands to medium sands. Interbedded with the major saturated zone soil units are discontinuous layers of clayey silt and sandy silt.

The measured groundwater flow direction at the Site is to the east at a hydraulic gradient of 4.0 feet per mile. The dissolved TCE plume extends approximately 100 feet from the source area (former pits) to the east in the direction of groundwater flow and extends approximately 60 feet to the north and south. The residual source is believed to cover an area of approximately 70 by 35 feet. The approximate vertical extent of the residual source outside of the building which has been excavated and removed from the site formerly extended from below the building foundation in the northwest building corner to a depth of 19 feet below grade. The vertical extent of the residual source inside the building, which has been excavated and removed from the site, formerly extended from below the building foundation in the northwest building corner to a depth of 13 feet below the building footer. The maximum estimated depth of the 10 milligrams per liter (mg/l) dissolved TCE concentration contour is modeled to range from 40 to 50 feet below grade directly below the projected residual source area.

UCCs goal for the final groundwater remedy is to reduce the trichloroethene (TCE) mass in the source/near source area. The mass reduction will be measured by the decline in dissolved groundwater concentrations at the Site. The target concentration range for dissolved TCE in groundwater at the Site is 1 to 10 mg/l.

The primary objectives of the current phase of ENVIROGEN's work at the Site were to verify/update UCCs conceptual model of the Site, and confirm the applicability of IAS technology for Site remediation.

Verification of the Site conceptual model involved collection and analyses of groundwater samples in areas where there were data gaps. (using a Geoprobe system). Headspace screening of volatile organic compounds (VOCs) in duplicate groundwater samples was used as a practical screening tool for defining the appropriate Geoprobe sampling locations.

In order to confirm the applicability of IAS technology for Site remediation, ENVIROGEN used the Geoprobe system to perform several brief soil vapor extraction (SVE) point permeability tests in the vadose zone soils and a brief IAS test in the saturated zone soils.

## **2.0 SITE INVESTIGATION APPROACH**

### **2.1 Groundwater Sampling and Head Space Screening**

Preliminary Geoprobe locations for groundwater sampling were chosen based on the available Site data and are described in ENVIROGEN's workplan for the Geoprobe work dated July 31, 1995. The final Geoprobe sampling locations used were determined in the field based on accessibility and on the results of headspace screening. The Geoprobe sampling services were performed by Petro Site Assessment (PSA) of Lee's Summit, MO. Disposable driving points were attached to 3 foot sections of stainless steel, one half inch inside diameter (ID) rods and were advanced using the hydraulic press mounted on the rear of a four wheel drive vehicle, until the desired sampling depth was reached. Threaded nipples used to connect sections of Geoprobe rods were sealed with Teflon tape and wrench tightened to insure that air being sampled during point permeability testing was derived from the selected discrete interval. Figure 1 shows the final Geoprobe sampling locations.

Groundwater samples were generally collected at depths of 20 and 30 feet below grade at each sampling location. The preliminary groundwater sampling depths proposed were 25 and 35 feet below grade, based on a projected depth to groundwater of 18 to 22 feet. However, during the Geoprobe sampling, the groundwater table was observed approximately 13 feet below grade. In response to the higher than expected groundwater table elevation, the discrete depths for Geoprobe sampling were raised five feet. At Geoprobe location G4 samples were collected at 20, 40, 50 and 60 feet below grade, at Geoprobe location G9 only one sample was collected at a depth of 20 feet below grade.

Once the desired depth for groundwater sampling was reached, the Geoprobe rods were retracted approximately one foot to expose an internal stainless steel screen. A section of Teflon tubing containing an in-line foot valve was inserted into the rods and connected to the stainless steel screen. Groundwater samples were collected after purging approximately 120 mls of groundwater from the tubing with a peristaltic pump. Groundwater samples were collected in duplicate 40 ml vials and stored in a refrigerator or on ice from the time of collection until delivery to the analytical laboratory. The samples were analyzed for halogenated volatile organic compounds using EPA method 8021.

In addition, approximately 60 mls of ground water were collected for jar headspace screening. Jar headspace screening was performed using a Thermo Environmental model 580B organic vapor meter (OVM) equipped with a photoionization detector which utilizes a 10.6 eV lamp and is calibrated to isobutylene. TCE's ionization potential is 9.47 eV, which is within the range of the 10.6 eV lamp. Prior to headspace screening, each groundwater sample was set in a water bath for at least 15 minutes to minimize temperature fluctuations between samples. The water bath temperature was recorded at the time of each headspace screening.

Headspace screening results were evaluated in the field using a 100 ppmv criteria which corresponds to 1 mg/l of dissolved TCE using Henry's Law. Again, a dissolved TCE concentration of 10 mg/l was being used to define the near source area. The headspace screening results provided real time estimates of dissolved TCE groundwater concentrations and were used to make field decisions with respect to final sample depths and locations.

## **2.2 Vapor Probe Installation and Point Permeability Testing**

ENVIROGEN vapor probes VP1 and VP2 were installed at Geoprobe locations G2 and G3, respectively, and were used to monitor IAS influence in vadose zone soils. The vapor probes consist of 6 inches of 1/2 inch inside diameter (ID) slotted poly vinyl chloride (PVC) screen connected to 3/16 inch ID Teflon tubing with a compression fitting. The Teflon tubing was protected with a 1/2 inch diameter schedule 40 PVC sleeve. The probes were installed in the borehole made with the Geoprobe assembly to a depth of approximately 11 feet below grade. The annulus between the screen and the edge of the borehole was backfilled with sand to a vertical thickness of one foot. The open Geoprobe borehole overlying the screen was backfilled to grade with bentonite chips.

Pneumatic point permeability testing was performed at several Geoprobe locations as they were being advanced in order to evaluate the range of air permeabilities in vadose zone soils across the Site. Point permeability tests were performed at Geoprobe locations G1, G2, G3 and G5 at depths of 1 foot and 5 feet above the static water table (13 feet below grade at time of testing) at each location. Point permeability testing was performed in a similar manner to the ground water sampling. The Geoprobe rods were retracted at the specified depth to expose a stainless steel screen, and vacuum pump was attached to the rods at the surface. The Teflon tubing used during groundwater sampling was not installed

during the point permeability testing because the smaller tubing diameter caused excessive head losses. A vacuum was applied to the top of the Geoprobe rods and the corresponding air flow rate and wellhead vacuum recorded. The tight soils encountered in the vadose zone at each Geoprobe depth and location allowed for point permeability testing to be performed at only one air flow rate.

### **2.3 In-Situ Air Sparging Testing**

In-situ air sparging feasibility testing was performed at Geoprobe location G4 at a screen depth of 25 feet below grade (12 feet below water table).

Prior to initiating the IAS test, background measurements of dissolved oxygen (DO), vadose zone VOC vapor concentrations, depths to groundwater, and helium vapor concentrations were measured at each of seven monitoring points used for the test (VP1, VP2, PZ2, MW11A, MW13A, MW13B, and MW14A).

The IAS testing procedure is similar to that used for point permeability testing. The Geoprobe system was used to drive the screen (GA) to a depth of 25 feet below grade, a compressor was connected directly to the rods and pressure was applied. Injected air flow rate and pressure at the wellhead were recorded. During the tests, and following termination of the tests several parameters were measured at the monitoring points to provide evidence of IAS influence.

One of the most definitive test involves the use of a tracer gas (helium) to aid in the evaluation of the zone of influence of the IAS test point. An air/ helium mixture was injected into the sparge point for the majority of the test duration and vapor samples are periodically collected from the seven monitoring points and screened using a helium detector.

## **3.0 SITE INVESTIGATION RESULTS**

### **3.1 Geoprobe Installation Locations**

The number and locations of the Geoprobe sampling locations varied slightly from those proposed in the workplan. Geoprobe G5 along the west side of the building was not proposed in the workplan but was installed while waiting for access to the railroad property. Geoprobe G4 was installed further west towards the corner of the fence and



building since the concrete pad at this location had been removed and was no longer an obstacle to Geoprobe system. Geoprobe G7 was moved several feet to the west in order to provide a more representative sampling grid between Geoprobos G4 and G5. In total, nine Geoprobe points were installed. Final Geoprobe installation locations are depicted in Figure 1.

### 3.2 Groundwater Head Space Screening Results

Results of the head space screening of groundwater samples are presented in Table 1. Discrete groundwater samples were collected from depths of 20 and 30 feet below grade. Head space screening results of samples collected at 20 feet below grade ranged from 55 parts per million on a volume basis (ppmv) as TCE at G6 (located between the railroad tracks) to 4,216 ppmv at G9 (located along the mid-point of the west wall of the facility building). Screening results at 30 feet below grade ranged from non-detectable at G6 to 1,374 ppmv at G1 (located at the front of the building).

Samples were also collected at GA at depths of 40, 50 and 60 feet below grade in order to detect any evidence of DNAPL pools that might exist in that location. Results of head space screening of these samples, though slightly elevated at a depth of 50 feet, did not demonstrate a consistent trend with depth.

### 3.3 Groundwater Sample Analysis Results

Generally, the correlation of headspace screening results with the laboratory analysis results was relatively good. Those samples that were found to have significant head space readings also had the highest dissolved concentrations of TCE as determined by the laboratory. A linear regression of aqueous laboratory and head space screening results (Appendix A) shows that the correlation was best at low concentrations and was less appropriate at high concentrations. However, the criteria was 100 ppmv, below which there was a strong linear relationship. Thus, the jar headspace screening method was a valid screening tool for making field decisions regarding the placement of Geoprobe sampling locations and depths.

A summary of the laboratory results is provided in Table 1; laboratory certificates of analysis are provided in Appendix B. The only VOCs detected were TCE, and 1,2 dichloroethene (DCE). Dissolved TCE concentrations ranged from 0.11 mg/l to 530 mg/l. Dissolved DCE, (Cis and Trans) concentrations ranged from 0.02 mg/l to 216 mg/l. The

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DCE concentrations at the Site are likely due to degradation of the TCE source since DCE is a well known daughter product of TCE.

Figures 2 and 3 present plan views of the Site showing dissolved TCE isoconcentration contour lines, based on the laboratory analyses of the groundwater samples, at 20 and 30 feet below grade, respectively. Figure 4 presents a Site cross section showing dissolved TCE concentrations with depth.

In the vicinity of the TCE source area, groundwater samples from 20 feet below grade exhibited higher TCE concentrations than those collected at 30 feet below grade. The highest dissolved concentration detected on Site was from the 20 foot sample at Geoprobe G3 (located just east of the center of the TCE source area). This sample contained 530 mg/l of TCE, which is close to 50 percent of TCE's solubility limit (1,100 mg/l), indicating possible contact with soils with residual TCE saturation. In upgradient and down gradient areas of the Site, samples collected at 30 feet below grade generally contained higher TCE concentrations than at the 20 foot depth intervals.

The vertical profile of sampling at Geoprobe G4 (located directly within the TCE source area) indicated that dissolved TCE concentrations are relatively high at 20 feet below grade (88 mg/l) and decline in concentration with depth to 14 mg/l and 16 mg/l at depths of 40 and 50 feet, respectively. However, the deepest groundwater sample collected from G4 at a 60 foot depth showed increased TCE levels (86 mg/l). This may suggest the potential for residual or free phase TCE product at depth; however, the Geoprobe data must be reviewed with discretion, since Geoprobe data represents a discrete data point which greatly increases variability between sampling points. Previous available monitor well data in the vicinity of G4 however, should also be considered when reviewing the Geoprobe data since monitor well data represents a weighted average concentration over the entire screen length.

The dissolved TCE contours, based on the Geoprobe data are shown in Figure 2 (based on 20 foot below grade depths). The data agrees reasonably well with the monitoring well data used to develop the Site conceptual model. The most notable correlation between the Geoprobe and monitor well data occurs in the vicinity of the TCE source area and near monitor well MW12. The Geoprobe data generally confirms the location and geometry of the TCE source area and dissolved plume width. However, as shown in Figure 2,

Geoprobe data from G8 indicates that the TCE source area extends slightly to the northwest.

The extent of the 10 mg/l dissolved TCE plume as shown in Figure 2 to the north and south of the TCE source area also correlates well with the Site conceptual model. Data from G2 confirms that migration of dissolved TCE has not extended significantly to the north beyond this point. However, Figure 2 also indicates that the 10 mg/l contour line extends to the front parking area, east of the facility building. The Geoprobe data also indicates the TCE plume has migrated in an upgradient direction to G6, although it appears that it does not extend beyond the adjacent railroad property.

### 3.4 Point Permeability Test Results

Point permeability testing was performed at two discrete depths at four Geoprobe locations. Testing was performed at approximately 5 feet and at 1 foot above the static groundwater table at each location. Table 2 presents the results of point permeability testing along with the calculated soil permeability at each location.

ENVIROGEN'S proprietary radially symmetric two-dimensional air flow model was utilized with the test data from each of the Geoprobe location to evaluate the horizontal intrinsic air permeability for the soils in close proximity to the Geoprobe point. The evaluation of the horizontal intrinsic permeability ( $K_r$ ) for each of the tested wells was used to determine the range of soil permeabilities at the Site and the feasibility of using soil vapor extraction (SVE) in conjunction with IAS as a remedial remedy.

Intrinsic permeabilities in the range exhibited across the Site are representative of very low to moderately low permeability soils. The calculated  $K_r$  for the soils ranged from  $6.42 \times 10^{-8} \text{ cm}^2$  at location G1 at a depth of 8 feet to  $7.7 \times 10^{-10} \text{ cm}^2$  at location G5 at a depth of 10 feet. In general, the results indicate higher permeabilities at depths less than 10 feet and lower permeabilities at depths greater than 10 feet. The soils within one foot of the static groundwater table appear to be much less permeable than soils located more than 5 feet above the static groundwater table. This is attributable to the partial pore saturation associated with the capillary zone.

### 3.5 In Situ Air Sparging Test Results

A brief IAS feasibility test (83 minutes) was performed at Geoprobe location G4 at a depth of approximately 25 feet below grade. Monitoring points consisting of vapor probes VP1, and VP2 and monitoring wells PZ2, MW11A, MW13A MW13B, and MW14A were used to measure physical and chemical indicators of IAS influence prior to, during and after the test. Results of IAS testing are summarized in Table 3.

Background and post test levels of helium, VOCs, depth to ground water and dissolved oxygen were collected at the seven monitoring points. Helium was measured at the monitoring points twice during the test.

Immediately following the start of the IAS test, the air injection flow was 4.5 cfm at a pressure of 11 PSI. Within several minutes of air injection, the flow rate declined to 2 cfm at a pressure of 7 psi.

In order to confirm the existence of airflow channels in the saturated zone, a tracer gas (helium) was injected into the sparging well. Several minutes after the start of the IAS test, helium was introduced into the injection well at a flow rate of 0.72 cfm for the remainder of the test.

Throughout the test, bubbling occurred within monitor well MW13A indicating that airflow channels propagating from the sparging well had intersected the MW13A screened interval, thereby, providing a release point for the injected air. Monitor well MW 13A is located 16 feet from the IAS test well. This observation indicates that the injected air is expanding laterally as major channels or pockets rather than moving vertically up into the vadose zone as bubbles or a uniform network of air channels.

A comparison of pre- and post- test levels of helium indicated that slight increases were observed at PZ2 and MW13B (at radial distances of 36 and 10.5 feet away from the injection well, respectively). The only monitoring point showing a significant helium increase was MW13A which was likely attributed to a saturated zone air channel or pocket discharging directly into the well screen and up through the water column rather than an air channel connecting the saturated and vadose zones.

Moderate increases in VOC concentrations in soil gas measured during pre- and post-testing were recorded in monitoring points VP1, VP2, PZ2. Fluctuations in groundwater levels measured during pre- and post- testing were recorded in only two monitoring points. Groundwater levels decreased by 1.2 feet and 1.0 feet in MW11A and MW14A, respectively. These decreases are evidence that groundwater was mounding in the vicinity of the sparging point.

Moderate increases in dissolved oxygen concentrations measured during pre- and post-testing were recorded only in MW13B (located 10.5 feet from the injection well).

Following termination of air injection, groundwater discharged from the top of the air injection well for about 10 minutes. This provides evidence that an air pocket had developed in the saturated zone during the period of IAS testing.

#### **4.0 IN-SITU AIR SPARGING FEASIBILITY**

The operating injection pressures and flow rates recorded during the IAS test indicate that the saturated zone soils 25 feet below grade are amenable to air injection and IAS technology. This assessment is supported by the fact that the steady state injection pressure required for testing (6.5 psi) was only slightly greater than the static water column pressure of 5.2.

However, the physical and chemical monitoring and other observations made during IAS testing indicate that the injected air does not achieve a good connection to the vadose zone, thereby inhibiting collection of sparged vapors by an SVE system. Additionally, injected air which did reach the vadose zone during IAS tests appeared to follow a preferential direction to the northeast of the air injection well. The following points support these evaluations:

- 1) There was no significant increase in helium vapor concentrations at any of the vadose zone monitoring points (except a monitor well where bubbling was observed in the saturated zone). In contrast, increases of helium vapor concentrations ranging from 5 to 15 percent are common in soils where a good connection between the saturated and vadose zone soils is achieved.

- 2) VOC vapor concentrations in the vadose zone did not increase to the extent expected from sparging in soils which were directly within a VOC source area. Additionally, the monitoring points which did show an increase in VOC vapor concentrations (VP1, VP2, and PZ2) were all located northeast of the sparge test well, indicating a preferred direction of saturated zone air channel formation.
- 3) Dissolved oxygen concentrations did not increase significantly over the duration of the test as would have been expected. Only one monitor well showed a moderate D.O. increase and its screened interval is at a deeper elevation than the sparging point elevation.
- 4) Several observations made during the IAS test suggest that the injected air formed air pockets in the saturated zone rather than a uniform distribution of vertical air channels to the vadose zone. These include no significant evidence of sparging influence measured in vadose zone soils, a measurable water table decline in two monitoring points following termination of the test, and discharge of groundwater from the test well following termination of the test (both later observation are due to collapse of the saturated zone air pocket).

Two explanations exist for the poor connection between the saturated zone where sparging tests were performed and the vadose zone soils. First is that the silt to fine sands which overlie the deeper fine to coarse sands may be acting as a confining layer which causes injected air pockets to form beneath the silty material and spread laterally. Note that the Site conceptual model described the groundwater table as occurring at a depth of approximately 18 to 22 feet below grade. During the Geoprobe investigations, the groundwater table was measured at a depth of 13 feet below grade. The result of the higher groundwater table elevation is that any potential vadose zone thickness which was expected within the deeper fine to coarse sands at the Site based on the Site conceptual model is not available for collecting sparged vapors.

Secondly, the stratification within the deeper fine to coarse sands, consisting of interbedded discontinuous lenses of clayey silt and silty sand, may also be causing lateral migration of sparged vapors and inhibit effective formation of vertical air channels into the vadose zone. An additional likelihood is that a combination of the two factors is occurring.

The hydrogeologic conditions observed during the Geoprobe investigation would adversely affect the performance of a standardly designed full scale IAS system in the following ways:

- 1) Lateral spreading of injected air would causing mixing and migration of the TCE dissolved plume potentially in undesirable directions.
- 2) The formation of air pockets requires the additional design consideration of an air release mechanism to limit lateral spreading.
- 3) The apparent preferred direction of injected air migration makes the IAS system design difficult due to lack of control of sparged vapors. This requires a closer IAS well spacing to ensure successful implementation.
- 4) The lack of a permeable vadose zone as observed during the IAS tests makes an SVE system for vapor collection less effective, thereby, requiring closer spaced SVE wells.

As a final note, the fundamental limitations associated with the applicability of IAS at the Site are related to the difficulties of collecting sparged VOC laden vapors before they spread any significant distance in a lateral direction. Although the overall Site hydrogeological conditions are not ideal for the application of IAS, the fundamental physical performance of the IAS test well indicates that IAS is feasible in the deeper fine to coarse sands. However, carefully designed controls need to be considered in the IAS design process to account for the limitations. These design controls are likely to consist of a saturated zone air relief mechanism which will collect sparged vapors and limit their lateral migration in lieu of an adequate natural vertical connection to the vadose zone.

## 5.0 CONCLUSIONS

The following conclusions are made in consideration of the primary site investigation objectives, which were to verify/update the Site conceptual model and to evaluate the feasibility of an IAS application at the Site.

1) The laboratory analysis results for groundwater samples collected during the Geoprobe investigation indicate generally good agreement with the Site conceptual model.

2) The areal extent of the TCE source area, which contains soils residually saturated with TCE, was generally confirmed by the Geoprobe investigation with the source area extending 10 to 20 feet further to the northwest.

3) Vertical sampling at multiple depths in the TCE source area indicated elevated dissolved concentrations of TCE at depths of 20 feet and again at 60 feet below grade. The concentrations observed at 60 feet could be reflective of DNAPL or residual TCE soil contamination.

disagrees  
w/ concep.  
model

4) The Geoprobe groundwater sampling data aided the delineation of TCE distribution at locations where limited data was available. The Site conceptual model has been refined as follows:

a) The limit of dissolved TCE migration in the down gradient (east) direction, as indicated by the 10 mg/l concentration line, extends further to the east than was indicated in the Site conceptual model.

probably  
even further  
than shown

b) The limit of dissolved TCE migration in the northern direction, as indicated by the 10 mg/l concentration line, does not appear to extend significantly beyond Geoprobe point G2.

need more  
points

c) The limit of dissolved TCE migration in the southern direction, as indicated by the 10 mg/l concentration line, agrees reasonably well with the Site conceptual model.

should have  
sampled  
G-5.

d) The limit of dissolved TCE migration in the upgradient (west) direction as indicated by the 10 mg/l concentration line extends to the middle of the adjacent railroad property but does not likely extend beyond the railroad property.

how do you  
know?



5) The results of SVE point permeability testing indicated that the current vadose zone soils are of low to moderately low intrinsic permeability. Soils within this range of intrinsic permeability are considered acceptable although not optimal with respect to the application of SVE.

↑  
minimally  
acceptable!  
↓

6) The results of IAS testing in the deep fine to coarse sand zone indicate that the application of IAS is feasible but that careful design controls must be considered in the IAS design process which will account for the adverse Site limitations. The adverse Site limitations are related to lateral spreading of injected air, migration of sparged vapors in preferred directions, and the formation of air pockets in the saturated zone.

## 6.0 RECOMMENDATIONS

Based on the Geoprobe investigation, several recommendations are proposed as outlined below:

1) The extent of TCE migration in an easterly direction was found to be greater than expected. Additionally, the vertical extent of TCE in the source area and in downgradient areas has not been confirmed. In order to confirm the horizontal and vertical TCE distribution across the Site, additional investigation work is required.

yes.

Groundwater samples should be collected for laboratory analysis from multiple depths in the source area (near G4) and in down gradient areas (near G1). The vertical groundwater sampling should be extended to refusal or to depths where TCE levels are not detectable. Additionally, groundwater samples should be collected from several depths at off-site location(s) in the vicinity of Brinkerhoff Road. This work could be most cost effectively accomplished with Geoprobe equipment.

off-site!

A set of nested monitor wells should be installed in the vicinity of Geoprobe G6; the screened intervals should be set at 20 to 30 feet below grade and 40 to 50 feet below grade, respectively. Groundwater from the nested monitor wells should be sampled and analyzed for VOCs to confirm the upgradient extent of dissolved TCE migration.

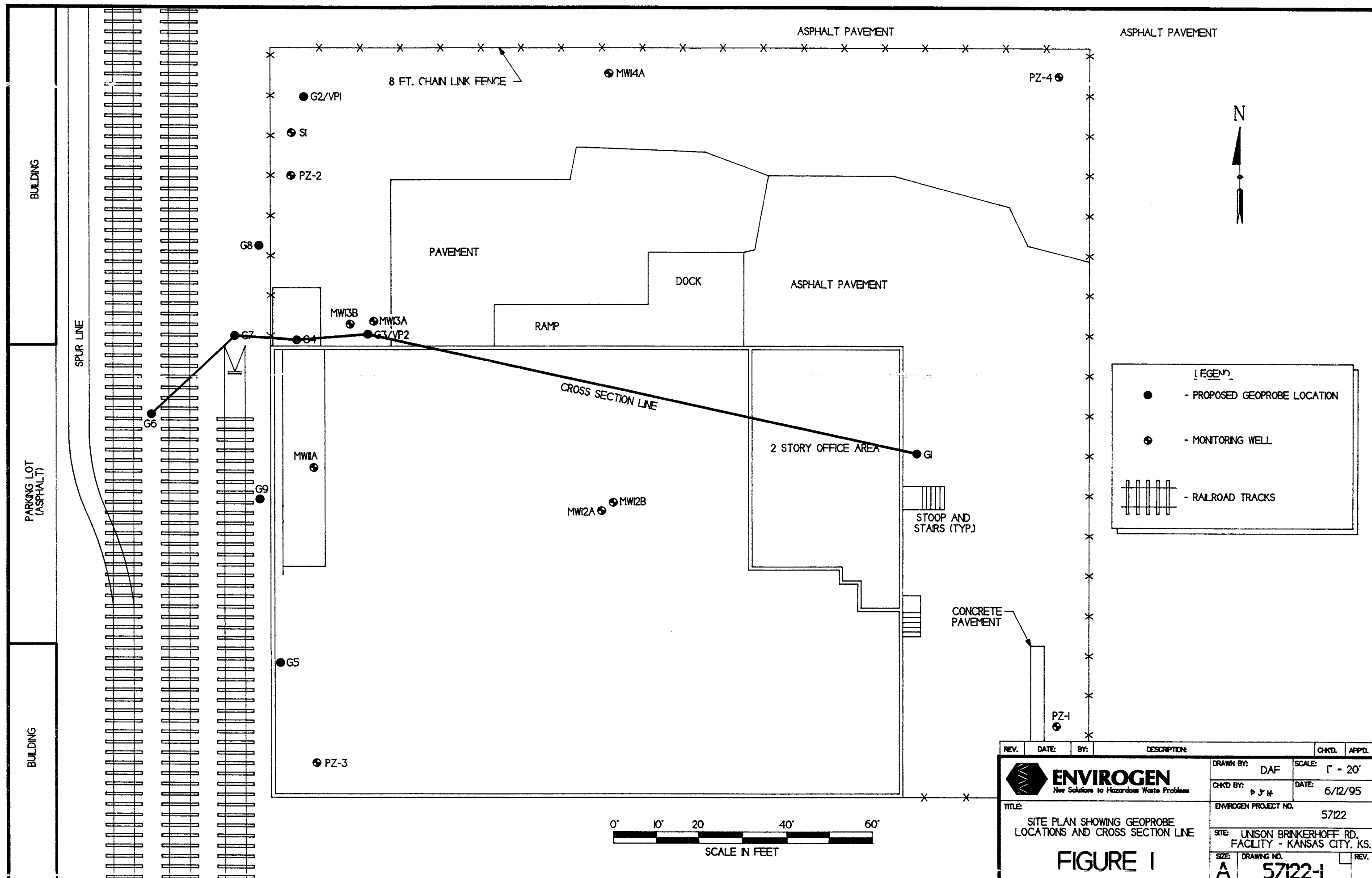
need to bedrock below source

2) The full range of groundwater table fluctuation and flow direction should be evaluated prior to designing the SVE/IAS field pilot test arrangement. This should include a review of current and historical water level data from Site specific and regional sources.

3) The second phase of Site investigations including SVE/IAS field pilot tests should be performed. The design of these tests should be modified from their original scope to include an evaluation of the predominant mechanism causing air pocket and/or anisotropic air channel formation (ie. an overlying confining strata or interbedded silty sand/clay lenses). Additionally, the vertical extent of IAS testing will be dependant on the results of Geoprobe screening in the TCE source area.

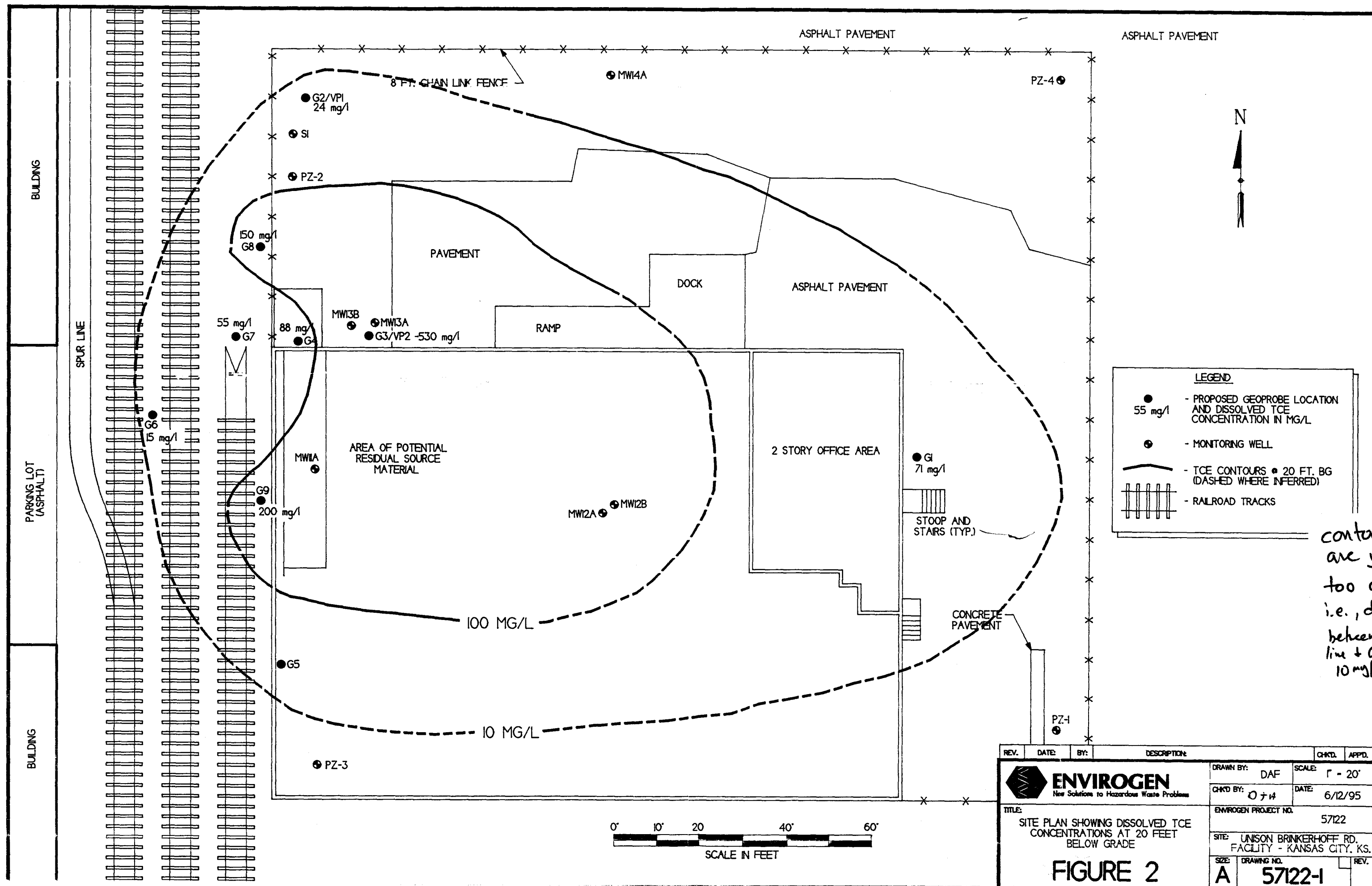
Specifically, IAS injection wells will be installed at one location in the TCE source area but at multiple depths to determine how significant changes in stratigraphy affect the IAS process. This evaluation requires the use of nested piezometers to evaluate lateral air pocket or air channel propagation. Based on the preliminary results of SVE/IAS field screening tests, injected air may be expanding in preferred directions which will require nested piezometers at varying radial distances and in several different directions in order to fully evaluate. The expanded piezometer network will also allow an evaluation of the use of an air relief mechanism for minimizing lateral spreading of sparged vapors.

4) Since the Site conceptual model assumed that the groundwater table occurred at a depth of 18-22 feet below grade within the fine to coarse sand zone, it was considered that SVE technology would be applied in the overlying source area silty sand zone. However, based on Site conditions encountered during the Geoprobe investigation, five to nine feet of the upper silty sand zone was within the saturated zone. Based on the fluctuating groundwater table elevation, an approach to removing TCE in the saturated portion of the upper silty sand zone within the TCE source area must be developed. An evaluation of the available remedial options will be completed prior to the next phase of SVE/IAS field pilot testing. If appropriate, field testing will be expanded to address TCE removal in the saturated silty sand zone which lies within the TCE source area.

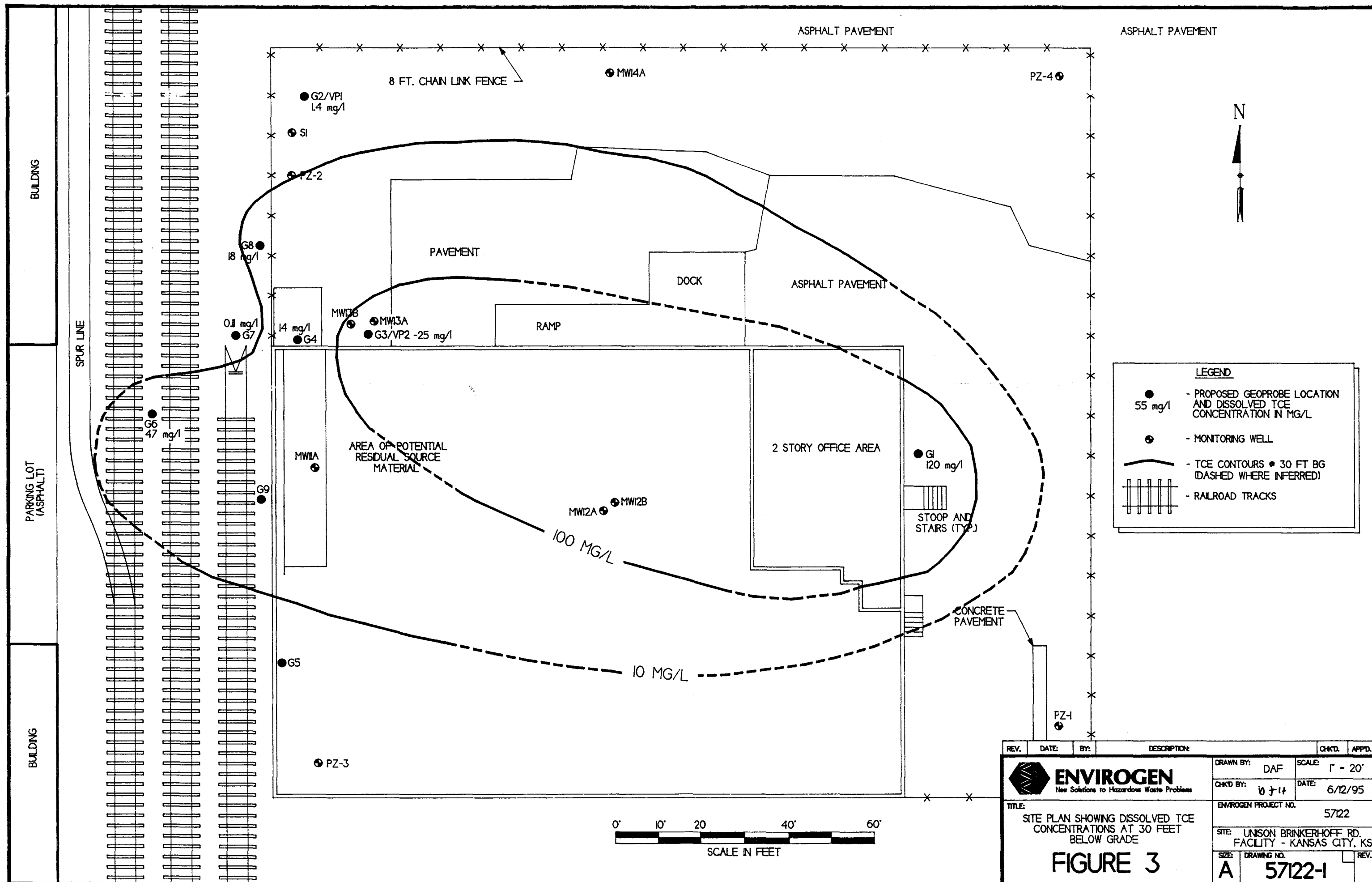


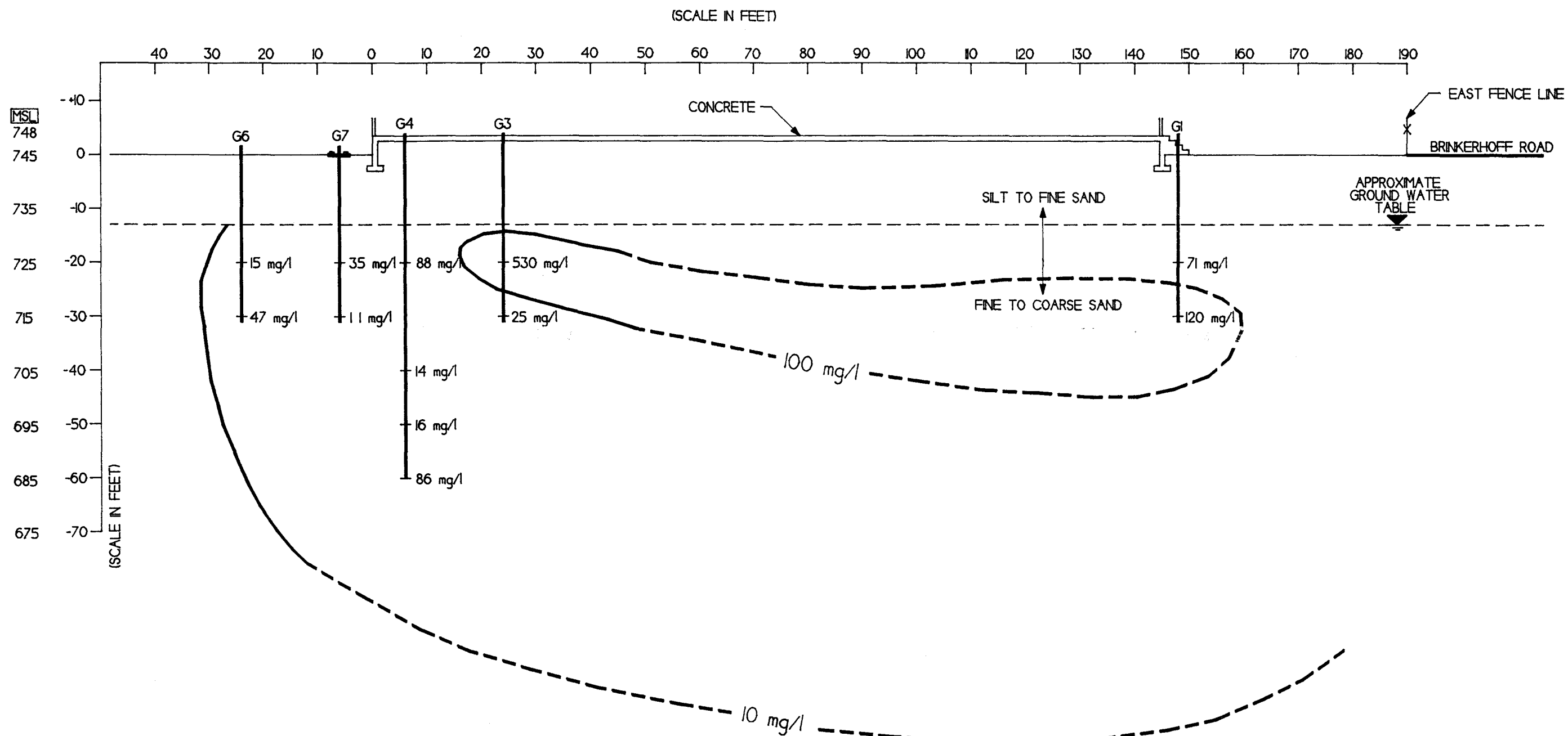
REV.	DATE	BY	DESCRIPTION	CHKD.	APPD.
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TITLE:			DRAWN BY: DAF		
			SCALE: 1" = 20'		
			CHKD BY: DJH		
			DATE: 6/12/95		
			ENVIROGEN PROJECT NO. 57122		
			SITE: UNISON BRINKERHOFF RD. FACILITY - KANSAS CITY, KS.		
			SIZE: A		
			DRAWING NO. 57122-1		
			REV.		

Previous sampling showed  
9.6 ppm <sup>TE</sup> in MW-14A



contours  
are way  
too optimist  
i.e., distance  
between 100 mg/L  
line + G1 +  
10 mg/L line





REV.	DATE	BY	DESCRIPTION	CHKD.	APP'D.
<b>ENVIROGEN</b> New Solutions to Hazardous Waste Problems			DRAWN BY: <b>DAF</b> SCALE: 1" = 20' CHKD BY: <b>DTH</b> DATE: 9/22/95		
TITLE: CROSS SECTION SHOWING VERTICAL DISTRIBUTION OF DISSOLVED TCE CONCENTRATIONS mg/l <b>FIGURE 4</b>			ENVIROGEN PROJECT NO. 57122 SITE: UNISON BRINKERHOFF RD. FACILITY - KANSAS CITY, KS. SIZE: <b>A</b> DRAWING NO. 57122-7 REV.		

# TABLE 1

## Jar Headspace Screening and Laboratory Analysis Results of Geoprobe Groundwater Samples

Brinkerhoff Road Facility – Kansas City, KS

August 1995

Geoprobe Location	Depth of Sample Collection (ft bg)	Jar Headspace Result (ppmv)	Temperature (F)*	Dissolved TCE Concentration (MG/L)	Dissolved Cis 1,2 DCE Concentration (MG/L)	Dissolved Trans 1,2 DCE Concentration (MG/L)
G-1	20	316	90	71	25.4	ND
G-1	30	1,374	93	120	0.41	ND
G-2	20	114	88	24	0.02	ND
G-2	30	12	86	1.4	0.7	ND
G-3	20	3,652	84	530	ND	ND
G-3	30	80	84	25	12.57	0.07
G-4	20	1,393	75	88	0.102	0.002
G-4	40	29	76	14	0.003	ND
G-4	50	215	76.5	16	0.7	ND
G-4	60	4	77	86	0.006	ND
G-5	21	NS	NS	NS	NS	NS
G-5	31	NS	NS	NS	NS	NS
G-6	20	55	79	15	13	ND
G-6	30	ND	79	47	5.6	ND
G-7	20	570	78	55	20	ND
G-7	30	46	78	0.11	9	ND
G-8	20	2,356	76	150	1.5	ND
G-8	30	58	76	18	2.9	ND
G-9	20	4,216	76	200	216	ND

ft bg Feet below grade.

ppmv Parts per million by volume.

\* Temperature refers to the temperature of the waterbath at the time of measurement.

MG/L Milligrams per liter (Also equivalent to parts per million (PPM)).

NS Geoprobe not sampled

ND Reported concentration is below method detection limit.

GP157122\GEOSAMP.WK1



TABLE 2

## Point Permeability Testing Results

Brinkerhoff Road Facility – Kansas City, KS

August 1995

Geoprobe Location	Depth of Testing (ft bg)	Wellhead Vacuum (in Hg)	Air Flow (scfm)	Vapor VOC Concentration (ppmv)	Horizontal Intrinsic Permeability (cm <sup>2</sup> )
G-1	8	5.9	1.90	ND	6.42E-08
G-1	12	20.0	0.35	ND	8.44E-10
G-2	8	9.0	1.60	333	8.45E-09
G-2	12	25.0	0	NS	NS
G-3	8	9.0	2.30	1,492	1.22E-08
G-3	12	25.0	0	NS	NS
G-5	10	25.6	0.28	116	7.71E-10
G-5	14	19.0	0.64	215	1.97E-09

G:\P\57122\PPTEST.WK1

(ft bg) Feet below grade.

\* Kr determined using ENVIROGEN's proprietary 2D model.

(ppmv) Parts per million on a volume basis as TCE.

ND Reported concentration is below method detection limit.

NS Geoprobe not sampled or test results were not applicable.

(cm<sup>2</sup>) Values of intrinsic permeability are determined using Envirogen's proprietary 2D model.

1x10<sup>-10</sup>  
is considered  
lower  
limit

TABLE 3

## Insitu Air Sparging Test Results

Brinkerhoff Road Facility – Kansas City, KS

August 1995

Test Point: G-4  
 Depth: 25 ft  
 Start Time: 11:17 AM  
 Stop Time: 12:40 PM  
 Test Duration: 1hr, 23min.  
 Avg. Injection Flow: 2.0 cfm  
 Avg Injection Pressure: 6.5 psi

Monitoring Point Configuration			Static Monitoring Parameters				Monitoring During Test		Post Test Monitoring Parameters*			
Time of Data Collection:			10:30am				11:25	12:00	1:00pm			
Location	Radial Distance From G-4 (ft)	Screen Interval (ft bg)	He %	VOC's (ppmv)	GW (ft bg)	DO (mg/l)	He %	He %	He %	VOC's (ppmv)	GW (ft bg)	DO (mg/l)
VP1	51	10-11	ND	ND	—	—	0.01	0.01	0.01	34	—	—
VP2	13	10-11	ND	8	—	—	0.03	0.04	0.02	34	—	—
PZ2	36	12-32	0.01	ND	12.8	0.5	0.02	ND	0.06	92	13.8	1.1
MW11A	30	15-25	0.03	ND	12.9	1.3	ND	0.01	0.02	8	12.9	0.9
MW13A**	16	15-25	ND	>2,000	12.7	0.5	0.02	0.51	15	>2,000	NM	0.2
MW13B	10.5	39-49	0.01	219	13.0	0.6	0.04	0.01	0.06	135	13.0	3.8
MW14A	94	20-30	0.01	29	12.8	0.7	—	0.01	ND	34	14.0	0.6

G:\P57122\A61.W

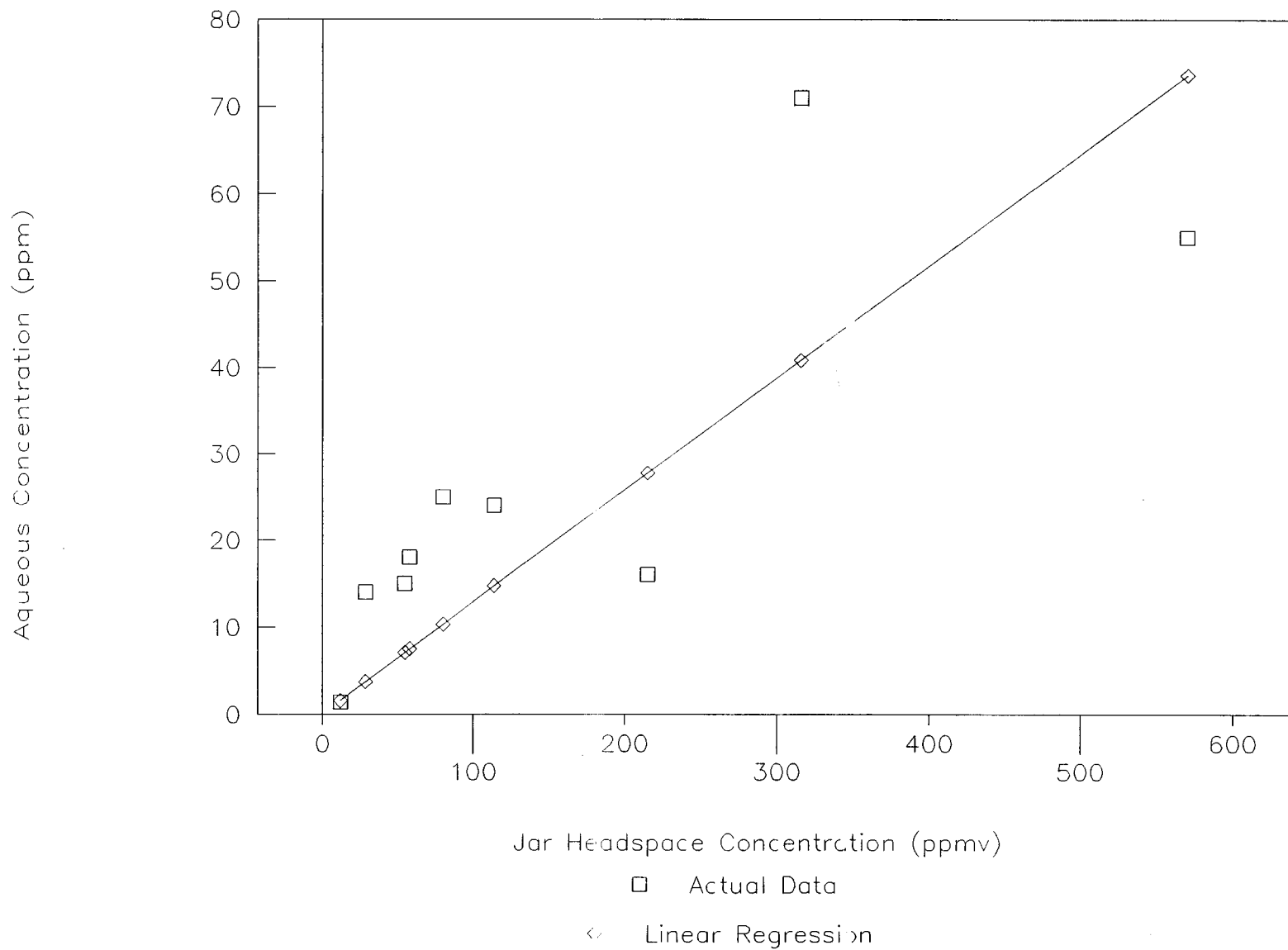
- ft bg Feet below grade.  
 HE% Percent helium as measured with portable helium detector.  
 VOCs (ppmv) Parts per million by volume as TCE as measured by an organic vapor monitor (OVM 580B).  
 GW (ft bg) Depth to groundwater in feet below grade as measured with a water level indicator.  
 DO (mg/l) Dissolved oxygen in ground water in Milligrams per litre (mg/l) as measured with YSI DO meter.  
 ND Measured reading was below instrument/method detection limit.  
 — Reading was not taken at this time.  
 \* Following termination of test, groundwater spouted from air injection probe G-4 for 10 minutes.  
 \*\* Bubbling within monitoring well water column was noted during test.

**APPENDIX A**

**CORRALATION OF HEADSPACE SCREENING  
TO LABORATORY ANALYSIS RESULTS**

# AQUEOUS vs VAPOR TCE CONC. (qualified)

BRINKERHOFF ROAD FACILITY - KANSAS CITY



NOT A  
GOOD FIT

**APPENDIX B**

**LABORATORY ANALYSIS RESULTS**



REVISED  
9-26-95

## REPORT OF LABORATORY ANALYSIS

COPY

September 20, 1995

Mr. Mark Liggatt  
Unison Transformer Services  
3126 Brinkerhoff Road  
Kansas City, KS 66115

RE: PACE Project Number: 606249  
Client Project ID: ENV.1

Dear Mr. Liggatt:

Enclosed are the results of analyses for samples received on September 1, 1995. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

A handwritten signature in dark ink, appearing to read "DeWayne McAllister". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

DeWayne McAllister  
Project Manager

Enclosures

# REPORT OF LABORATORY ANALYSIS

DATE: 09/20/95  
PAGE: 1

Unison Transformer Services  
3126 Brinkerhoff Road  
Kansas City, KS 66115

PACE Project Number: 606249  
Client Project ID: ENV.1

Attn: Mr. Mark Liggatt  
Phone: (913)321-3155

PACE Sample No: 60452737  
Client Sample ID: G1-20

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	71000	ug/L	600	09/12/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	25400	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	160	%		09/12/95	EPA 8021	HMF	74-97-5	
a,a,a-Trifluorotoluene (S)	136	%		09/12/95	EPA 8021	HMF	2164-17-2	

PACE Sample No: 60452745  
Client Sample ID: G1-30

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	120000	ug/L	1200	09/12/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	405.5	ug/L	6	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	2.5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	134	%		09/12/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452752  
Client Sample ID: G2-20

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	24000	ug/L	600	09/12/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	15.6	ug/L	1.2	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	0.5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	141	%		09/12/95	EPA 8021	HMF	74-97-5	

# REPORT OF LABORATORY ANALYSIS

DATE: 09/20/95

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PACE Project Number: 606249

Client Project ID: ENV.1

PACE Sample No: 60452760  
Client Sample ID: G2-30

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	1400	ug/L	24	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	690	ug/L	1200	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	153	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452778  
Client Sample ID: G3-20

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	530000	ug/L	12000	09/16/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	ND	ug/L	12000	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	5000	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	108	%		09/16/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452786  
Client Sample ID: G3-30

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	25000	ug/L	600	09/12/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	12500	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	70	ug/L	0.5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	174	%		09/12/95	EPA 8021	HMF	74-97-5	1

PACE Sample No: 60452794  
Client Sample ID: TB1

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	ND	ug/L	1.2	09/13/95	EPA 8021	HMF	79-01-6	



# REPORT OF LABORATORY ANALYSIS

DATE: 09/20/95  
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PACE Project Number: 606249  
Client Project ID: ENV.1

PACE Sample No: 60452794  
Client Sample ID: TB1

Date Collected: 08/29/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
cis-1,2-Dichloroethene	ND	ug/L	1.2	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	0.5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	128	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452810  
Client Sample ID: G4-20

Date Collected: 08/30/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	88000	ug/L	600	09/12/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	133	ug/L	1.2	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	2.2	ug/L	0.5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	147	%		09/12/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452828  
Client Sample ID: G4-40

Date Collected: 08/30/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	14000	ug/L	600	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	2.54	ug/L	1.2	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	0.5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	158	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452836  
Client Sample ID: G4-50

Date Collected: 08/30/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	16000	ug/L	600	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	7000	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	165	%		09/13/95	EPA 8021	HMF	74-97-5	

# REPORT OF LABORATORY ANALYSIS

DATE: 09/20/95  
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PACE Project Number: 606249  
Client Project ID: ENV.1

PACE Sample No: 60452844  
Client Sample ID: G4-60

Date Collected: 08/30/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	121	ug/L	1.2	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	6.3	ug/L	1.2	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	0.5	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	133	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452851  
Client Sample ID: G6-20

Date Collected: 08/31/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	15000	ug/L	600	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	13000	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	183	%		09/13/95	EPA 8021	HMF	74-97-5	2

PACE Sample No: 60452869  
Client Sample ID: G6-30

Date Collected: 08/31/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	47000	ug/L	600	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	5600	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	158	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452877  
Client Sample ID: G7-20

Date Collected: 08/31/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	55000	ug/L	600	09/13/95	EPA 8021	HMF	79-01-6	

# REPORT OF LABORATORY ANALYSIS

DATE: 09/20/95

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PACE Project Number: 606249

Client Project ID: ENV.1

PACE Sample No: 60452877  
Client Sample ID: G7-20

Date Collected: 08/31/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
cis-1,2-Dichloroethene	20000	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	173	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452885  
Client Sample ID: G7-30

Date Collected: 08/31/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	110	ug/L	1.2	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	9000	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	168	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452893  
Client Sample ID: G8-20

Date Collected: 08/31/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	150000	ug/L	1200	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	1500	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	143	%		09/13/95	EPA 8021	HMF	74-97-5	

PACE Sample No: 60452901  
Client Sample ID: G8-30

Date Collected: 08/31/95  
Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	18000	ug/L	600	09/13/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	2900	ug/L	600	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	155	%		09/13/95	EPA 8021	HMF	74-97-5	

# REPORT OF LABORATORY ANALYSIS

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PACE Project Number: 606249  
 Client Project ID: ENV.1

PACE Sample No: 60452919 Date Collected: 08/31/95  
 Client Sample ID: G9-20 Date Received: 09/01/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Halogen. & Aromatic Vol. Orgs.								
Trichloroethene	200000	ug/L	3000	09/16/95	EPA 8021	HMF	79-01-6	
cis-1,2-Dichloroethene	216000	ug/L	3000	09/12/95	EPA 8021	HMF	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	1250	09/12/95	EPA 8021	HMF	156-60-5	
Bromochloromethane (S)	122	%		09/16/95	EPA 8021	HMF	74-97-5	

## REPORT OF LABORATORY ANALYSIS

DATE: 09/20/95  
PAGE: 7

PACE Project Number: 606249  
Client Project ID: ENV.1

---

### PARAMETER FOOTNOTES

ND	Not Detected
NC	Not Calculable
PRL	PACE Reporting Limit
(S)	Surrogate
[1]	The surrogate recovery was high due to matrix interference and coelution. Reanalysis was done and results were duplicated. Therefore, results were accepted.
[2]	The surrogate recovery was high due to matrix interference and coelution. Reanalysis was done and results were duplicated. Therefore, results were accepted.

# REPORT OF LABORATORY ANALYSIS

## QUALITY CONTROL DATA

DATE: 09/20/95  
PAGE: 8

Unison Transformer Services  
3126 Brinkerhoff Road  
Kansas City, KS 66115

PACE Project Number: 606249  
Client Project ID: ENV.1

Attn: Mr. Mark Liggatt  
Phone: (913)321-3155

QC Batch ID: 11884      QC Batch Method: EPA 8021      Date of Batch: 09/10/95  
Associated PACE Samples:      60452737      60452745      60452752      60452760      60452778  
   60452786      60452794      60452810      60452828      60452836  
   60452844      60452851      60452869      60452877      60452885  
   60452893      60452901      60452919

METHOD BLANK: 60459823  
Associated PACE Samples:

Parameter	Units	Method Blank Result	PRL	Footnotes
Trichloroethene	ug/L	ND	1.2	
Bromochloromethane (S)	%	150		
a,a,a-Trifluorotoluene (S)	%	145		

METHOD BLANK: 60471901  
Associated PACE Samples:

Parameter	Units	Method Blank Result	PRL	Footnotes
Trichloroethene	ug/L	ND	1.2	
Bromochloromethane (S)	%	132		

# REPORT OF LABORATORY ANALYSIS

QUALITY CONTROL DATA

DATE: 09/20/95  
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PACE Project Number: 606249  
Client Project ID: ENV.1

METHOD BLANK: 60471919  
Associated PACE Samples:

60452760 60452836 60452851 60452869 60452877 60452901

Parameter	Units	Method Blank Result	PRL	Footnotes
Trichloroethene	ug/L	ND	1.2	
Bromochloromethane (S)	%	126		
a,a,a-Trifluorotoluene (S)	%	138		

METHOD BLANK: 60471927  
Associated PACE Samples:

60452828 60452844

Parameter	Units	Method Blank Result	PRL	Footnotes
Trichloroethene	ug/L	ND	1.2	
Bromochloromethane (S)	%	154		
a,a,a-Trifluorotoluene (S)	%	143		

METHOD BLANK: 60473543  
Associated PACE Samples:

60452778 60452919

Parameter	Units	Method Blank Result	PRL	Footnotes
Trichloroethene	ug/L	ND	1.2	
Bromochloromethane (S)	%	128		
a,a,a-Trifluorotoluene (S)	%	127		

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 60459849 60459856

Parameter	Units	60452737	Spike Conc.	Matrix Spike Result	Spike % Rec	Matrix Sp. Dup. Result	Spike Dup % Rec	RPD	Footnotes
Trichloroethene	ug/L	71000	20000	79000	39	78000	37	5	
Bromochloromethane (S)					136		135		

LABORATORY CONTROL SAMPLE: 60459831

Parameter	Units	Spike Conc.	LCS Result	Spike % Rec	Footnotes
Trichloroethene	ug/L	20	27	133	
Bromochloromethane (S)				132	
a,a,a-Trifluorotoluene (S)				131	

## REPORT OF LABORATORY ANALYSIS

DATE: 09/20/95

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PACE Project Number: 606249

Client Project ID: ENV.1

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### QUALITY CONTROL DATA PARAMETER FOOTNOTES

The Quality Control Sample Final Results listed above have been rounded to reflect an appropriate number of significant figures. Consistent with EPA guidelines unrounded concentrations have been used to calculate % Rec and RPD values.

ND	Not Detected
NC	Not Calculable
PRL	PACE Reporting Limit
RPD	Relative Percent Difference
(S)	Surrogate